

# **Appendix E**

## **Incident Frequency Study**



## Incident Frequency Study

A project-specific incident frequency analysis was conducted for the Project. This document represents an evaluation of the public safety risks associated with the *Over The River Project* (Project). This report focuses on hazards associated with the three phases of the Project: Installation, Exhibition, and Removal. Hazards are categorized as construction-related, public safety related, and natural hazards.

The purpose of this report is to provide a conservative range of effect to public and worker safety during the Project. This analysis will provide supplemental information for local emergency responders, providing an estimate of the frequency of certain hazards, allowing emergency responders the opportunity to prepare for various scenarios in its emergency response preparation and planning.

This study assessed various manmade and natural hazards associated with the Project and the Project area and estimated the frequency for eight hazards associated with human activities and ten natural hazards. When possible, the study quantified risk based on the frequency of the event.

### 1.1 Incident Frequency

Incident frequencies were derived from publicly available records, such as the Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (Fremont County Emergency Services Division [FCESD] 2003), and other data provided within the EIS. Risk from natural hazards was quantifiable, while risk from human activities was generally semi-quantifiable.

While future events cannot be known with absolute certainty, incident frequencies can be used to estimate the number of events that might be expected to occur over a period of time based on historic frequencies. Actual frequency may differ from the predicted values of this analysis.

### 1.2 Methodology

Man-made and natural hazards currently exist within the Project Area. However, the Project introduces hazards from construction and public safety issues related to increased visitation. Natural hazards are common in the area, but their impacts will likely be greater with increased human visitation. Alternatives to the Proposed Action may reduce some hazards to the viewing public.

Risk was calculated by determining the baseline frequency of an event and the seasonal duration of the event. For example, severe lightning storms occur 5 times per year on average, and these events tend to occur in July and August. Activities that avoid the July and August timeframes thereby largely avoid these hazards (e.g., installation would not occur in these summer months, so risk from lightning was considered nominal). Activities that coincide with these timeframes (e.g., Exhibition in August) may experience these events. The probability of an event is:

$$\text{Frequency of event} * \text{exposure time} * \text{length of project}$$

For example, the exhibition period for the Proposed Action occurs within the severe lightning storms period of July and August, an 8 week period. Large numbers of the visiting public would be exposed to these storms during the 2 weeks of the Exhibition phase, plus additional visitors anticipated one week prior to the event. In total, the exposure period for high public exposure is 3 weeks total. Thus, hazard to the public is:

$$5 \text{ severe storms}/8 \text{ weeks} * 3 \text{ weeks public exposure} = 1.1 \text{ severe storm event during the Exhibition Phase}$$

This result indicates that emergency responders should anticipate a high probability of a severe storm with lightning during the Exhibition phase. Hazard severity was classified as High (more than one event during Project Phase), Moderate (between 0.1 and 1.0 events during project phase), Low (between 0.01 and 0.1 events during Project phase), and Remote (less than 0.01 events during Project phase).

Emergency responders would implement the procedures identified in the Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003). To further mitigate hazards to the public and ensure effective responses, the proponents of the Project should coordinate their Event Management Plan with the appropriate local, state, and federal entities to ensure all parties understand the hazards and jointly agree to procedures that would be implemented during the Project.

## 2.0 Proposed Action

**Table 1** summarizes construction-related and public safety hazards associated with the Proposed Action, while **Table 2** identifies natural hazards associated with the Proposed Action. The quantification and impacts of each hazard is discussed in the sections below.

### 2.1 Construction-Related Hazards

During the installation and removal processes, construction workers would be exposed to various work hazards, ranging from potentially minor (poison ivy) to potentially major accidents (significant falls, vehicle accidents). No construction activities would occur during the Exhibition phase and therefore no hazards to construction workers would be present. Due to the nature of the construction work, the primary hazards are expected to be related to the physical environment (trips, falls, poison ivy, bee stings, cuts and scrapes), mechanical equipment (drilling and cable stringing), and travel to and from the workplace. Travel on winding roads, particularly during winter snow storms, pose a threat to workers. A job safety analysis, emphasis on worker safety, and compliance with rules and regulations should maintain a relatively safe worker environment.

For this analysis, construction hazards were classified as 1) OSHA-reportable injury (requiring minor medical attention), 2) serious injury (requiring hospitalization and/or the loss of work days), or 3) injuries caused by equipment failure. It is noted that there is potential overlap between these categories. With the use of proper safety equipment and procedures, most injuries are anticipated to be minor. Serious injuries or substantive equipment failures leading to injuries are expected to be uncommon.

The hazard analysis for construction-related injuries is semi-quantitative. The Proposed Action is considered the baseline rate. Alternatives that reduce or eliminate a hazard would quantitatively affect the baseline rate. For example, the Proposed Action is expected to take two years to install. An alternative to the Proposed Action that reduced the construction time period to one year (e.g., Alternative 1b) would reduce the hazards to workers by 50%. However, if adequate construction crews and relief workers are not provided during the intense work schedule, the potential for construction-related accidents from human error may increase. The No Action Alternative would completely eliminate construction activities, thereby completely eliminating this hazard to workers.

**Table 1. Construction-Related and Project-Related Public Safety Hazards for the Proposed Action.**

		Construction Safety			Project-Specific Public Safety				
		OSHA-reportable Construction Injury	Severe Construction Injury	Equipment failure	Vandalism	Boating Accident <sup>1</sup>	Severe Boating Accident <sup>1</sup>	Traffic problems	Criminal Actions
	Event frequency	2/year	1/2 years	1/10 years		15/year <sup>2</sup>	3/year <sup>2</sup>		
Installation (2 years duration)	Occurrence Probability (number of events)	Baseline	Baseline	Baseline	Not significantly different than No Action	3.8 more than No Action	0.8 more than No Action	Baseline	Not significantly different than No Action
	Risk Category	Moderate to High	Low to Moderate	Low	Low	High	Moderate	Low	Low
Exhibition (2 week period with a total of 3 weeks of high use)	Occurrence Probability (number of events)	NA	NA	NA	2.4 times greater than No Action	3.8	0.8	2.4 times greater than No Action	2.4 times greater than No Action
	Risk Category	NA	NA	NA	High	High	High	High	High
Removal (3 months)	Occurrence Probability (number of events)	Baseline	Baseline	Baseline	Not significantly different than No Action	2.8 more than No Action	0.6 more than No Action	Baseline	Not significantly different than No Action
	Risk Category	Low	Low	Low	Low	High	High	Moderate	Low

<sup>1</sup> Based on data provided in baseline section of EIS.

<sup>2</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: This table represents the baseline, the Proposed Action. Some comparison is made to the No Action in this table. Additional comparison is made in the other alternative tables through green and yellow highlights in relation to the Proposed Action.

**Table 2.** Natural Hazards Associated with the Proposed Action.

		Natural Hazards									
		Rock fall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm <sup>3</sup>	Earthquake > 5.5 Richter scale <sup>4</sup>
Event frequency		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year <sup>6</sup>	2/100 years <sup>6</sup>
Installation (2 years duration)	Occurrence Probability (number of events)	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	6.7	0.004
	Risk Category	NA	NA	NA	NA	NA	NA	NA	NA	High	Remote
Exhibition (2 week period with a total of 3 weeks of high use)	Occurrence Probability (number of events)	1.1	1.9	0.04	0.04	0.2	0.08	0.2	0.8	0.0	0.001
	Risk Category	High	High	Low	Low	Moderate	Low	Moderate	Moderate	Remote	Remote
Removal (3 months)	Occurrence Probability (number of events)	0.75	1.3	0.03	0.01	0.1	0.20	0.4	0.8	0.8	0.0050
	Risk Category	Moderate	High	Low	Low	Moderate	Moderate	Moderate	Moderate	Moderate	Remote

<sup>1</sup> Based on two month seasonal event (e.g., severe summer storms in July and August)

<sup>2</sup> Based on three month summer season

<sup>3</sup> Based on eight month season for possible winter storms

<sup>4</sup> Based on annual probability

<sup>5</sup> Based on data provided in baseline section of EIS

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003)

Note: This table represents the baseline, the Proposed Action. Some comparison is made to the No Action in this table. Additional comparison is made in the other alternative tables through green and yellow highlights in relation to the Proposed Action.

## 2.2 Public Safety Hazards

Human behavior poses the greatest risk to public safety for the Project. Vandalism and criminal activity are expected to increase proportionally with the number of visitors.

Boating accidents are expected to significantly increase due to the proximity of the panels and cable to the water's surface. Cables and panels are expected to be 8 to 20 feet above the water's surface and will create an attractive nuisance to boaters. It should be anticipated that boaters will attempt to hang onto or grapple onto the cable. Others will throw items into the panels. These behaviors will likely result in an increase in mishaps, some which may cause injuries and require swift water rescues. Due to potential consequences to the boating permits, commercial operators may be more vigilant about controlling people within their rafts than private boating parties.

For this analysis, we estimated the number of boating incidents would increase twofold once the cables were installed and would continue through the removal of the cables. The estimation of boating accidents was quantitatively analyzed, as described previously. Thus, during the Exhibition period for the Proposed Action, the hazard to the public is calculated as:

$$\begin{aligned} & \mathbf{15 \text{ boating accidents}/12 \text{ week boating season} * 3 \text{ weeks public exposure} * 2 \text{ times normal rate} =} \\ & \mathbf{7.5 \text{ boating accidents during the Exhibition Phase}} \end{aligned}$$

and

$$\begin{aligned} & \mathbf{3 \text{ severe boating accidents}/12 \text{ week boating season} * 3 \text{ weeks public exposure} * 2 \text{ times normal rate} =} \\ & \mathbf{1.5 \text{ severe boating accidents during the Exhibition Phase}} \end{aligned}$$

In total for the Installation, Exhibition, and Removal phases of the Project, this analysis indicates that the Proposed Action will result in an additional 14.1 boating accidents, with 2.9 severe boating accidents. These are accidents above the normal levels (e.g., the No Action Alternative). Consequently, if the Proposed Action were selected, emergency responders should plan on a substantial increase in the number of boating accidents, swift water rescues, and severe injuries during the Project. It will be important to have sufficient emergency responders available, good communications, and emergency crews must be able to quickly access the river and transport injured boaters from the area. These issues are addressed in the Project's Event Management Plan and should be directly coordinated with the appropriate local emergency response coordinators.

Traffic congestion is expected to be significant due to the number of vehicles, driver behavior, and potential for breakdowns. Traffic problems are expected to be proportional to the number of vehicles during peak viewing periods. Traffic due to construction workers is not expected to significantly affect baseline traffic rates.

The analysis for traffic congestion is semi-quantitative. The Proposed Action is considered the baseline rate. Alternatives that reduce or eliminate a hazard would quantitatively affect the baseline rate. For example, the Proposed Action Exhibition period is expected to last three weeks (one week prior to actual installation and the two week viewing period itself). An alternative to the Proposed Action that increased the Exhibition phase (e.g., Alternative 1c) would proportionally increase the length of time traffic congestion was experienced along Highway 50. The No Action Alternative would eliminate the Exhibition of the Project, thereby completely eliminating this hazard.

### 2.3 Natural Hazards

While natural hazards will occur regardless of the alternative selected for the Project (i.e., same as No Action frequency rates), it is the number of people present during these natural events that pose a potential hazard to public and worker safety. Natural hazards identified for this analysis include:

- Rock Falls
- Lightning
- Tornadoes
- Strong Wind Gusts
- Flash Floods
- Seasonal Flooding
- Wildfire
- Landslides
- Severe Winter Storms
- Earthquakes

Many of these hazards have been identified and accounted for within the Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003) as well as the proponents Event Management Plan. Frequencies for these events were derived from the Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003) or from baseline data within this EIS whenever possible.

These natural hazards create both direct and indirect hazards to the public and construction workers. For example, rock falls could cause injury or mortality if the rock fall occurred directly onto a vehicle. The greater the number of visitors in the Project Area, the higher the possibility of rock falls striking vehicles. However, the more probable occurrence would be rock falls that obstruct traffic, resulting in traffic congestion and difficulties evacuating the affected area. The majority of natural hazards pose similar hazards.

Lightning, rock fall, landslides, and wildlife pose the greatest hazards, with lightning posing the greatest hazard. All of these hazards are expected to occur at least once within the Project timeframe. Consequently, emergency responders should be particularly aware of these hazards in their event planning. As with other hazards, it will be important to be able to re-route traffic quickly and efficiently and to have sufficient emergency responders available, good communications, and emergency crews capable of quickly accessing all areas of the Project, and be able to transport injured people from the affected area.

### 3.0 Alternative 1c

Unlike the Proposed Action, Alternative 1c would remove all boat rations but would extend the viewing period for an additional week. **Table 3** summarizes construction-related and public safety hazards associated with Alternative 1c, while **Table 4** identifies natural hazards associated with Alternative 1c. The quantification and impacts of each hazard is discussed in the sections below.

#### 3.1 Construction-Related Hazards

Alternative 1c would be constructed within a two year timeframe, same as the Proposed Action. As a result, Construction related hazards are the same as the Proposed Action

### **3.2 Public Safety Hazards**

Vandalism and criminal activity during Installation and Removal phases would be the same as the Proposed Action since both occur over the same period of time. In Alternative 1c, the Exhibition phase would increase the number of people in the Project area for an additional week, therefore the amount of vandalism and criminal activities may be increase during this phase compared to the Proposed Action.

Alternative 1c would increase unpermitted boating activity, particularly during the Exhibition phase. As a result, boating accidents would be increased 39 percent (see footnote 1) compared to the Proposed Action with 9.8 more accidents and 2.0 more severe boating accidents than for the No Action alternative.

### **3.3 Natural Hazards**

Like the Proposed Action, the Installation phase (except the installation of cables) would avoid summer months thereby would avoid natural hazards. The Exhibition phase would occur in August and would have one additional week of viewing compared to the Proposed Action. As a result, increases in some natural hazards would be anticipated. Natural hazards associated with Alternative 1c would be the same as the Proposed Action.

**Table 3. Construction-Related and Project-Related Public Safety Hazards for Alternative 1c.**

	Frequency	OSHA-reportable Construction Injury	Severe Construction Injury	Equipment failure	Vandalism	Boating Accident <sup>1</sup>	Severe Boating Accident <sup>1</sup>	Traffic problems	Criminal Actions
		2/year	1/2 years	1/10 years		15/year <sup>2</sup>	3/year <sup>2</sup>		
<b>Installation</b> (2 year duration)	<b>Occurrence Probability (number of events)</b>	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	More than the Proposed Action	More than the Same As Proposed Action	Same As Proposed Action	Same As Proposed Action
	<b>Risk Category</b>	Moderate to High	Low to Moderate	Low	Low	High	Moderate	Low	Low
<b>Exhibition</b> (2 week period with a total of 3 weeks of high use)	<b>Occurrence Probability (number of events)</b>	NA	NA	NA	1.4 times greater than Proposed Action; 3.5 times greater than No Action	39 % more than Proposed Action (9.8 incidents more than No Action)	39 % more than Proposed Action (2.0 incidents more than No Action)	1.4 times greater than Proposed Action; 3.5 times greater than No Action	1.4 times greater than Proposed Action; 3.5 times greater than No Action
	<b>Risk Category</b>	NA	NA	NA	High	High	Moderate	High	High
<b>Removal</b> (3 moths)	<b>Occurrence Probability (number of events)</b>	Baseline	Baseline	Baseline	Not significantly different than Proposed Action	None Not significantly different than Proposed Action	None Not significantly different than Proposed Action	Not significantly different than Proposed Action	Not significantly different than Proposed Action
	<b>Risk Category</b>	Low	Low	Low	Low	Action	Action	Moderate	Low

<sup>1</sup> Based on data provided in baseline section of EIS.

<sup>2</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

**Table 4. Natural Hazards Associated with Alternative 1c.**

		Natural Hazards									
		Rock fall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm <sup>3</sup>	Earthquake > 5.5 Richter scale <sup>4</sup>
Frequency		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year <sup>6</sup>	2/100 years <sup>6</sup>
Installation (1 year duration)	Occurrence Probability (number of events)	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	3.3	0.002
	Risk Category	NA	NA	NA	NA	NA	NA	NA	NA	High	Remote
Exhibition (2 week period with a total of 3 weeks of high use)	Occurrence Probability (number of events)	1.5	2.5	0.05	0.05	0.2	0.08	0.2	0.8	0.0	0.001
	Risk Category	High	High	Low	Low	Moderate	Low	Moderate	Moderate	Remote	Remote
Removal (3 moths)	Occurrence Probability (number of events)	0.8	1.3	0.03	NA	0.1	0.05	0.1	0.5	1.3	0.0008
	Risk Category	Moderate	High	Low	NA	Moderate	Low	Moderate	Moderate	High	Remote

<sup>1</sup> Based on two month seasonal event (e.g., severe summer storms in July and August)

<sup>2</sup> Based on three month summer season

<sup>3</sup> Based on eight month season for possible winter storms

<sup>4</sup> Based on annual probability

<sup>5</sup> Based on data provided in baseline section of EIS

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003)

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

## 4.0 Alternative 1D

Compared to the Proposed Action, the Exhibition period would occur in September and additional boating rations would be allowed during this time period. Alternative 1d would **Table 5** summarizes construction-related and public safety hazards associated with Alternative 1d, while **Table 6** identifies natural hazards associated with Alternative 1d. The quantification and impacts of each hazard is discussed in the sections below.

### 4.1 Construction-Related Hazards

Alternative 1d would be constructed within a two year timeframe, same as the Proposed Action. As a result, construction related hazards are the same as the Proposed Action.

### 4.2 Public Safety Hazards

Vandalism and criminal activity during Installation, Exhibition and Removal phases would be the same as the Proposed Action since both occur over the same period of time. In Alternative 1d, the Exhibition phase would occur in September and the number of boating rations would increase. An additional 21,400 additional boaters are anticipated to use the river in September. The extension of the boating season with additional boaters results in a 33 % increase in the number of boating incidents, compared to the Proposed Action.

### 4.3 Natural Hazards

Compared to the Proposed Action, shifting the Exhibition phase to September in Alternative 1d reduces natural hazards that the viewing public would experience since the Exhibition phase would occur outside of the severe summer storm period (July-August). Only the Removal phase likely would experience an increase in hazards for construction workers, since the removal process would be more likely to encounter severe winter weather, than experienced in the Proposed Action.

**Table 5. Construction-Related and Project-Related Public Safety Hazards for Alternative 1d.**

		Construction Safety			Project-specific Public Safety				
		OSHA-reportable Construction Injury 2/year	Severe Construction Injury 1/2 years	Equipment failure 1/10 years	Vandalism	Boating Accident <sup>1</sup> 15/year <sup>2</sup>	Severe Boating Accident <sup>1</sup> 3/year <sup>2</sup>	Traffic problems	Criminal Actions
<b>Installation</b> (2 years duration)	<b>Frequency</b>								
	<b>Occurrence Probability (number of events)</b>	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Same as Proposed Action	Same as Proposed Action	Same As Proposed Action	Same As Proposed Action
	<b>Risk Category</b>	Moderate to High	Low to Moderate	Low	Low	High	Moderate	Low	Low
<b>Exhibition</b> (2 week period with a total of 3 weeks of high use)	<b>Occurrence Probability (number of events)</b>	NA	NA	NA	Same As Proposed Action	33 % increase in accidents compared to Proposed Action	33 % increase in accidents compared to Proposed Action	Same As Proposed Action	Same As Proposed Action
	<b>Risk Category</b>	NA	NA	NA	High	High	High	High	High
<b>Removal</b> (3 months)	<b>Occurrence Probability (number of events)</b>	Baseline	Baseline	Baseline	Not significantly different than No Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Not significantly different than No Action
	<b>Risk Category</b>	Low	Low	Low	Low	High	High	Moderate	Low

<sup>1</sup> Based on data provided in baseline section of EIS.

<sup>2</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

**Table 6. Natural Hazards Associated with Alternative 1d.**

		Natural Hazards									
		Rock fall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm *****	Earthquake > 5.5 Richter scale
	<b>Frequency</b>	3 times/	5/year <sup>6</sup>	1/10	1 in 10	1 in 2 years	4 in 10	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year *	2/100 years *

		year <sup>5</sup>	years <sup>6</sup>	years <sup>5</sup>	<sup>6</sup>	years <sup>6</sup>						
<b>Installation</b> (2 years duration)	<b>Occurrence Probability (number of events)</b>	Avoids seasonal event	3.3	0.002								
	<b>Risk Category</b>	NA	High	Remote								
<b>Exhibition</b> (2 week period with a total of 3 weeks of high use)	<b>Occurrence Probability (number of events)</b>	Avoids seasonal event	Increase compared to Proposed Action (0.06 events)	Same as Proposed Action								
	<b>Risk Category</b>	High	High	Low	Low	Moderate	Low	Moderate	Moderate	Moderate	Low	Remote
<b>Removal</b> (3 months)	<b>Occurrence Probability (number of events)</b>	Avoids seasonal event	Same as Proposed Action	Same as Proposed Action								
	<b>Risk Category</b>	Moderate	High	Low	Low	Moderate	Low	Moderate	Moderate	Moderate	Moderate	Remote

<sup>1</sup> Based on two month seasonal event (e.g., severe summer storms in July and August)

<sup>2</sup> Based on three month summer season

<sup>3</sup> Based on eight month season for possible winter storms

<sup>4</sup> Based on annual probability

<sup>5</sup> Based on data provided in baseline section of EIS

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003)

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

## 5.0 Alternative 2

In contrast to Alternatives 1a-d that modified visitor management and altered viewing and construction timetables, Alternatives 2 through 4 modify the length and number of panels displayed along the Arkansas River.

Alternative 2 reduces the length of the Project display to 4.6 miles, compared to the 5.9 miles for the Proposed Action. This represents a 22 percent reduction in Project length. **Table 7** summarizes construction-related and public safety hazards associated with Alternative 2, while **Table 8** identifies natural hazards associated with Alternative 2. The quantification and impacts of each hazard is discussed in the sections below.

### 5.1 Construction-Related Hazards

Alternative 2 would be 22 percent shorter in length than the Proposed Action, with all other factors being consistent with the Proposed Action. As a result, construction hazards associated with the Installation and Removal phases would be reduced by 22 percent.

### 5.2 Public Safety Hazards

Vandalism and criminal activity during Installation and Removal phases would be the same as the Proposed Action since both occur over the same period of time. In Alternative 2, the display would be shorter in length, which might reduce vandalism and criminal activity, though the frequency of vandalism and criminal activity would generally be correlated with the number of visitors rather than the length of the display.

Boating incidents would increase over the No Action levels due to misbehavior described previously. However, the reduction of the number of panels and the overall length of the display would proportionally decrease opportunities for behavior leading to accidents. Consequently, boating accidents would decrease 24 percent<sup>1</sup> relative to the Proposed Action.

### 5.3 Natural Hazards

Reducing the length of the displays may have little to no effect on natural hazard rates if visitors must still traverse the entire corridor to view the display. Nevertheless, public activities presumably would be more concentrated in the display areas, resulting in the potential reduction of up to 22 percent compared to the Proposed Action.

## 6.0 Alternative 3

Alternative 3 reduces the length of the Project display to 3.4 miles, compared to the 5.9 miles for the Proposed Action. This represents a 42 percent reduction in Project length. **Table 9 CONSTRUCT** summarizes construction-related and public safety hazards associated with Alternative 3, while **Table 10 NATURAL** identifies natural hazards associated with Alternative 3. The quantification and impacts of each hazard is discussed in the sections below.

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<sup>1</sup> The percent of boating accidents is not equivalent to the percent reduction in project length due to a weighting factor for display areas minus baseline boating accident levels without this weighting.

**Table 7. Construction-Related and Project-Related Public Safety Hazards for Alternative 2.**

		Construction Safety			Project-Specific Public Safety				
		OSHA-reportable Construction Injury 2/year	Severe Construction Injury 1/2 years	Equipment failure 1/10 years	Vandalism	Boating Accident <sup>1</sup> 15/year <sup>2</sup>	Severe Boating Accident <sup>1</sup> 3/year <sup>2</sup>	Traffic problems	Criminal Actions
Frequency									
Installation (2 years duration)	Occurrence Probability (number of events)	22% less than Proposed Action	22% less than Proposed Action	22% less than Proposed Action	Same as Proposed Action	22 % less than Proposed Action (2.9 incidents more than No Action)	22 % less than Proposed Action (0.6 incidents more than No Action)	Same as Proposed Action	Same as Proposed Action
	Risk Category	Moderate to High	Low to moderate	Low	Low	High	Moderate	Low	Low
Exhibition (2 week period with a total of 3 weeks of high use)	Occurrence Probability (number of events)	NA	NA	NA	Potentially less than Proposed Action	22 % less than Proposed Action (4.4 incidents more than No Action)	22 % less than Proposed Action (0.9 incidents more than No Action)	Potentially less than Proposed Action	Potentially less than Proposed Action
	Risk Category	NA	NA	NA	High	High	High	High	High
Removal (3 months)	Occurrence Probability (number of events)	22% less than Proposed Action	22% less than Proposed Action	22% less than Proposed Action	Not significantly different than Proposed Action	22% less than Proposed Action (2.2 incidents more than No Action)	22% less than Proposed Action (0.4 incidents more than No Action)	Not Significantly Different than Proposed Action	Not significantly different than Proposed Action
	Risk Category	Low	Low	Low	Low	High	High	Moderate	Low

<sup>1</sup> Based on data provided in baseline section of EIS.

<sup>2</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

**Table 8. Natural Hazards Associated with Alternative 2.**

		Natural Hazards										
		Rock fall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm <sup>3</sup> *****	Earthquake > 5.5 Richter scale	
		3 times/ year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year *	2/100 years *	
Installation (2 years duration)	Frequency										Potentially up to 22 % less than Proposed Action	Potentially up to 22 % less than Proposed Action
	Occurrence Probability (number of events) Risk Category	Avoids seasonal event NA	Avoids seasonal event NA	Avoids seasonal event NA	Avoids seasonal event NA	Avoids seasonal event NA	Avoids seasonal event NA	Avoids seasonal event NA	Avoids seasonal event NA	Avoids seasonal event NA	High	Remote
Exhibition (2 week period with a total of 3 weeks of high use)	Frequency										Potentially up to 22 % less than Proposed Action	Potentially up to 22 % less than Proposed Action
	Occurrence Probability (number of events) Risk Category	Potentially up to 22 % less than Proposed Action High	Potentially up to 22 % less than Proposed Action High	Potentially up to 22 % less than Proposed Action Low	Potentially up to 22 % less than Proposed Action Low	Potentially up to 22 % less than Proposed Action Moderate	Potentially up to 22 % less than Proposed Action Low	Potentially up to 22 % less than Proposed Action Moderate	Potentially up to 22 % less than Proposed Action Moderate	Potentially up to 22 % less than Proposed Action Moderate	Remote	Remote
Removal (3 months)	Frequency										Potentially up to 22 % less than Proposed Action	Potentially up to 22 % less than Proposed Action
	Occurrence Probability (number of events) Risk Category	Potentially up to 22 % less than Proposed Action Moderate	Potentially up to 22 % less than Proposed Action High	Potentially up to 22 % less than Proposed Action Low	Potentially up to 22 % less than Proposed Action Low	Potentially up to 22 % less than Proposed Action Moderate	Potentially up to 22 % less than Proposed Action Moderate	Potentially up to 22 % less than Proposed Action Moderate	Potentially up to 22 % less than Proposed Action Moderate	Potentially up to 22 % less than Proposed Action Moderate	Moderate	Remote

<sup>1</sup> Based on two month seasonal event (e.g., severe summer storms in July and August)

<sup>2</sup> Based on three month summer season

<sup>3</sup> Based on eight month season for possible winter storms

<sup>4</sup> Based on annual probability

<sup>5</sup> Based on data provided in baseline section of EIS

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003)

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

### **6.1 Construction-Related Hazards**

Alternative 3 would be 42 percent shorter in length than the Proposed Action, with all other factors being consistent with the Proposed Action. As a result, construction hazards associated with the Installation and Removal phases would be reduced by 42 percent.

### **6.2 Public Safety Hazards**

Vandalism and criminal activity during Installation and Removal phases would be the same as the Proposed Action since both occur over the same period of time. In Alternative 3, the display would be shorter in length, which might reduce vandalism and criminal activity, though the frequency of vandalism and criminal activity would generally be correlated with the number of visitors rather than the length of the display.

Boating incidents would increase over the No Action levels due to misbehavior described previously. However, the reduction of the number of panels and the overall length of the display would proportionally decrease opportunities for behavior leading to accidents. Consequently, boating accidents would decrease 42 percent relative to the Proposed Action.

### **6.3 Natural Hazards**

Reducing the length of the displays may have little to no effect on natural hazard rates if visitors must still traverse the entire corridor to view the display. Nevertheless, public activities presumably would be more concentrated in the display areas, resulting in the potential reduction of up to 42 percent compared to the Proposed Action.

**Table 9. Construction-Related and Project-Related Public Safety Hazards for Alternative 3.**

		Construction Safety			Project-Specific Public Safety				
		OSHA-reportable Construction Injury 2/year	Severe Construction Injury 1/2 years	Equipment failure 1/10 years	Vandalism	Boating Accident <sup>1</sup> 15/year <sup>2</sup>	Severe Boating Accident <sup>1</sup> 3/year <sup>2</sup>	Traffic problems	Criminal Actions
Installation (2 years duration)	Frequency								
	Occurrence Probability (number of events)	Baseline	Baseline	Baseline	Not significantly different than No Action	42 % less than Proposed Action (0.6 incidents more than No Action)	42 % less than Proposed Action (0.1 incidents more than No Action)	Baseline	Not significantly different than No Action
	Risk Category	moderate to High	Low to moderate	Low	Low	High	Moderate	Low	Low
Exhibition (2 week period with a total of 3 weeks of high use)	Occurrence Probability (number of events)	NA	NA	NA	Potentially less than Proposed Action	42 % less than Proposed Action (3.2 incidents more than No Action)	42 % less than Proposed Action (0.6 incidents more than No Action)	Potentially less than Proposed Action	Potentially less than Proposed Action
	Risk Category	NA	NA	NA	Moderate to High	High	High	High	Moderate
Removal (3 months)	Occurrence Probability (number of events)	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	39 % less than Proposed Action (0.6 incidents more than No Action)	39 % less than Proposed Action (0.1 incidents more than No Action)	Same as Proposed Action	Same as Proposed Action
	Risk Category	Low	Low	Low	Low	High	High	Moderate	Low

<sup>1</sup> Based on data provided in baseline section of EIS.

<sup>2</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

**Table 10. Natural Hazards Associated with Alternative 3.**

		Natural Hazards									
		Rock fall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm *****	Earthquake > 5.5 Richter scale
		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year *	2/100 years *
Frequency	Occurrence Probability (number of events)	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Potentially up to 42 % less than Proposed Action	Potentially up to 42 % less than Proposed Action (0.001 events)
	Risk Category	NA	NA	NA	NA	NA	NA	NA	NA	High	Remote
Installation (2 years duration)	Occurrence Probability (number of events)	Potentially 42% less than Proposed Action (0.6 events)	Potentially 42% less than Proposed Action (1.1 events)	Potentially 42% less than Proposed Action (0.02 events)	Potentially 42% less than Proposed Action (0.02 events)	Potentially 42% less than Proposed Action (0.1 events)	Potentially 42% less than Proposed Action (0.04 events)	Potentially 42% less than Proposed Action (0.1 events)	Potentially 42% less than Proposed Action (0.4 events)	Potentially 42% less than Proposed Action	Potentially 42% less than Proposed Action (0.001 events)
	Risk Category	Moderate	High	Low	Low	Moderate	Low	Moderate	Moderate	Remote	Remote
Exhibition (2 week period with a total of 3 weeks of high use)	Occurrence Probability (number of events)	Potentially 42% less than Proposed Action (0.4 events)	Potentially 42% less than Proposed Action (0.7 events)	Potentially 42% less than Proposed Action (0.01 events)	Potentially 42% less than Proposed Action (0.006 events)	Potentially 42% less than Proposed Action (0.07 events)	Potentially 42% less than Proposed Action (0.03 events)	Potentially 42% less than Proposed Action (0.1 events)	Potentially 42% less than Proposed Action (0.3 events)	Potentially 42% less than Proposed Action	Potentially 42% less than Proposed Action (0.0004 events)
	Risk Category	Moderate	Moderate	Low	Remote	Low	Low	Low	Moderate	Moderate	Remote
Removal (3 months)	Occurrence Probability (number of events)	Potentially 42% less than Proposed Action (0.4 events)	Potentially 42% less than Proposed Action (0.7 events)	Potentially 42% less than Proposed Action (0.01 events)	Potentially 42% less than Proposed Action (0.006 events)	Potentially 42% less than Proposed Action (0.07 events)	Potentially 42% less than Proposed Action (0.03 events)	Potentially 42% less than Proposed Action (0.1 events)	Potentially 42% less than Proposed Action (0.3 events)	Potentially 42% less than Proposed Action	Potentially 42% less than Proposed Action (0.0004 events)
	Risk Category	Moderate	Moderate	Low	Remote	Low	Low	Low	Moderate	Moderate	Remote

<sup>1</sup> Based on two month seasonal event (e.g., severe summer storms in July and August)

<sup>2</sup> Based on three month summer season

<sup>3</sup> Based on eight month season for possible winter storms

<sup>4</sup> Based on annual probability

<sup>5</sup> Based on data provided in baseline section of EIS

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003)

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

## 7.0 Alternative 4

Alternative 4 reduces the length of the Project display to 1.3 miles, compared to the 5.9 miles for the Proposed Action. This represents a 78 percent reduction in Project length. **Table 11** summarizes construction-related and public safety hazards associated with Alternative 4, while **Table 12** identifies natural hazards associated with Alternative 4. The quantification and impacts of each hazard is discussed in the sections below.

### 7.1 Construction-Related Hazards

Alternative 4 would be 78 percent shorter in length than the Proposed Action, with all other factors being consistent with the Proposed Action. As a result, construction hazards associated with the Installation and Removal phases would be reduced by 78 percent.

### 7.2 Public Safety Hazards

Vandalism and criminal activity during Installation and Removal phases would be the same as the Proposed Action since both occur over the same period of time. In Alternative 3, the display would be shorter in length, which might reduce vandalism and criminal activity, though the frequency of vandalism and criminal activity would generally be correlated with the number of visitors rather than the length of the display.

Boating incidents would increase over the No Action levels due to misbehavior described previously. However, the reduction of the number of panels and the overall length of the display would proportionally decrease opportunities for behavior leading to accidents. Consequently, boating accidents would decrease 42 percent relative to the Proposed Action.

### 7.3 Natural Hazards

Reducing the length of the displays may have little to no effect on natural hazard rates if visitors must still traverse the entire corridor to view the display. Nevertheless, public activities presumably would be more concentrated in the display areas, resulting in the potential reduction of up to 42 percent compared to the Proposed Action.

**Table 11. Construction-Related and Project-Related Public Safety Hazards for Alternative 4.**

		Construction Safety			Project-Specific Public Safety				
		OSHA-reportable Construction Injury	Severe Construction Injury	Equipment failure	Vandalism	Boating Accident <sup>1</sup>	Severe Boating Accident <sup>1</sup>	Traffic problems	Criminal Actions
Frequency		2/year	1/2 years	1/10 years		15/year <sup>2</sup>	3/year <sup>2</sup>		
Installation (1 year duration)	Occurrence Probability (number of events)	44 % less than Proposed Action	44 % less than Proposed Action	44 % less than Proposed Action	44 % less than Proposed Action	78 % less than Proposed Action	78 % less than Proposed Action	44 % less than Proposed Action	44 % less than Proposed Action
	Risk Category	Moderate to High	Low to Moderate	Low	Low	High	Moderate	Low	Low
Exhibition (2 week period with a total of 3 weeks of high use)	Occurrence Probability (number of events)	NA	NA	NA	Potentially less than Proposed Action	84 % less than Proposed Action (1.2 additional incidents)	84 % less than Proposed Action (0.2 additional incidents)	Potentially less than Proposed Action	Potentially less than Proposed Action
	Risk Category	NA	NA	NA	Moderate to High	High	High	High	Moderate
Removal (3 months)	Occurrence Probability (number of events)	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	79 % less than Proposed Action	79 % less than Proposed Action	Same as Proposed Action	Same as Proposed Action
	Risk Category	Low	Low	Low	Low	High	High	Moderate	Low

<sup>1</sup> Based on data provided in baseline section of EIS.

<sup>2</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

**Table 12. Natural Hazards Associated with Alternative 4.**

		Natural Hazards									
		Rock fall****	Lightning ****	Tornado ****	Wind gust ****	Flash Floods ****	Seasonal Flooding ***	Wildfire***	Landslide ****	Winter Storm *****	Earthquake > 5.5 Richter scale
<b>Frequency</b>		3 times/year **	5/year *	1/10 years *	1 in 10 years **	1 in 2 years *	4 in 10 years	1 per year *	2 per year *	2/year *	2/100 years *
<b>Installation</b> (1 year duration)	<b>Occurrence Probability (number of events)</b>	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Avoids seasonal event	Potentially up to 78 % less than Proposed Action (1.5 events)	Potentially up to 78 % less than Proposed Action (0.004 events)
	<b>Risk Category</b>	NA	NA	NA	NA	NA	NA	NA	NA	High	Remote
<b>Exhibition</b> (2 week period with a total of 3 weeks of high use)	<b>duration</b>	0.25	0.4	0.01	0.008	0.04	0.02	0.04	0.2	0.00000	0.00025
	<b>Occurrence Probability (number of events)</b>	Potentially up to 78 % less than Proposed Action (0.2 events)	Potentially up to 78 % less than Proposed Action (0.4 events)	Potentially up to 78 % less than Proposed Action (0.01 events)	Potentially up to 78 % less than Proposed Action (0.008 events)	Potentially up to 78 % less than Proposed Action (0.04 events)	Potentially up to 78 % less than Proposed Action (0.02 events)	Potentially up to 78 % less than Proposed Action (0.04 events)	Potentially up to 78 % less than Proposed Action (0.2 events)	Potentially up to 78 % less than Proposed Action	Potentially up to 78 % less than Proposed Action (0.0003 events)
	<b>Risk Category</b>	Moderate	Moderate	Low	Remote	Low	Low	Low	Moderate	Remote	Remote
<b>Removal</b> (3 months)	<b>Occurrence Probability (number of events)</b>	Potentially up to 78 % less than Proposed Action (0.2 events)	Potentially up to 78 % less than Proposed Action (0.3 events)	Potentially up to 78 % less than Proposed Action (0.006 events)	Potentially up to 78 % less than Proposed Action (0.002 events)	Potentially up to 78 % less than Proposed Action (0.03 events)	Potentially up to 78 % less than Proposed Action (0.01 events)	Potentially up to 78 % less than Proposed Action (0.03 events)	Potentially up to 78 % less than Proposed Action (0.1 events)	Potentially up to 78 % less than Proposed Action (0.3 events)	Potentially up to 78 % less than Proposed Action (0.0002 events)
	<b>Risk Category</b>	Moderate	Moderate	Remote	Remote	Low	Low	Low	Moderate	Moderate	Remote

<sup>1</sup> Based on two month seasonal event (e.g., severe summer storms in July and August)

<sup>2</sup> Based on three month summer season

<sup>3</sup> Based on eight month season for possible winter storms

<sup>4</sup> Based on annual probability

<sup>5</sup> Based on data provided in baseline section of EIS

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003)

Note: Green highlighted areas indicate hazards that are less than the Proposed Action; yellow areas are hazards that are greater than the Proposed Action.

## 8.0 Conclusions

Based on the available information, this hazard analysis indicates that the magnitude of risk associated with the Project is primarily a function of 1) duration of construction, 2) duration of exhibition, 3) timing of exhibition period, 4) length of the project along the river, and 4) boating activity levels. These factors affect the number of people exposed to manmade and natural hazards, thus increasing or decreasing risk.

### Reference

Fremont County Emergency Services Division (FCESD) (2003). Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area. 78 pp.